1.2 Vectors in 2-D (pg 11-22)

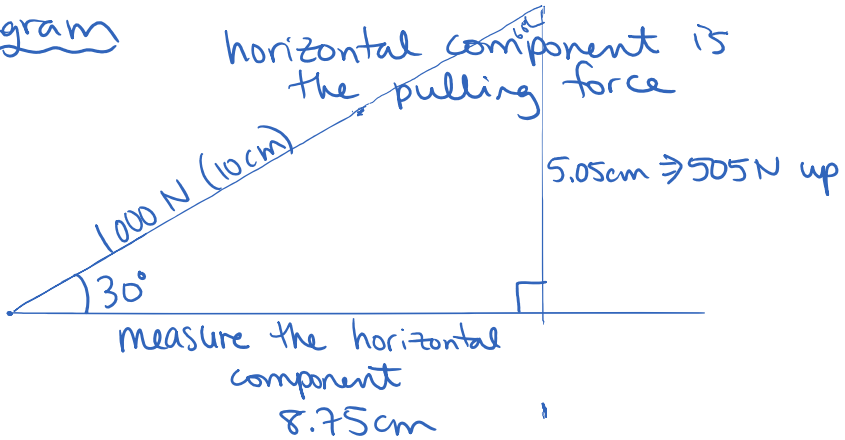
September 12, 2017 10:44 AM

Example: pulling a sled

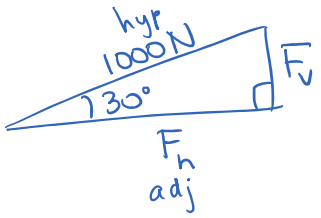
Force of 1000N along rope
What force actually pulls the sled forward?

Solution 1: Scale Diagram

let 1 cm = 100N
use a protractor + ruler



Solution 2: Trig



$$\cos 30^\circ = \frac{F_h}{1000\,N}$$

$$F_h = 1000N(\cos 30^\circ)$$

$$= 866N$$

Note: - any vector can be broken into 2 components, x and y are easiest/most useful
- the x and y components, added head to tail, equal the original vector.

What does the vertical component equal and mean?

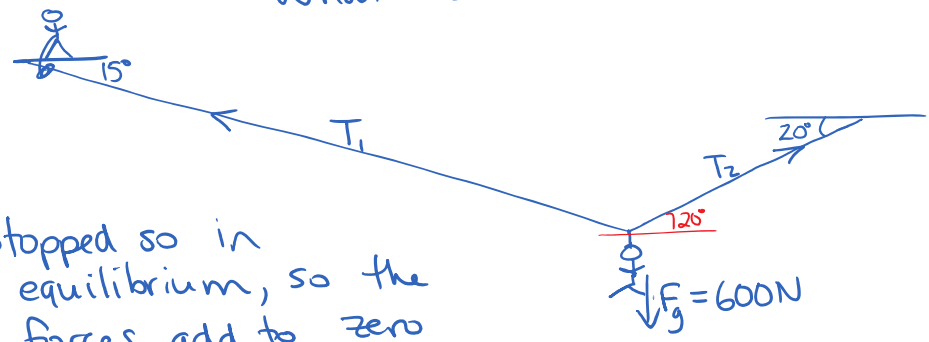
$$F_V = 1000N(\sin 30^\circ) = 500N$$

This 500N will reduce F_g, and thus F_N, so $F_f = \mu F_N$ will be less.

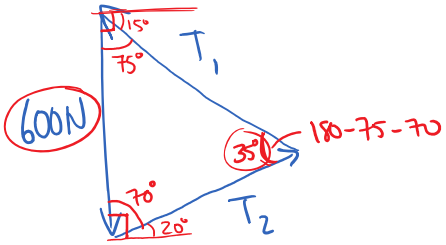
Tension Problems

Tension - the force exerted along the rope/string

Example a zipliner stopped part way along. What is the tension in each rope?



Stopped so in equilibrium, so the forces add to zero



Sine Law

$$\frac{T_1}{\sin 70^\circ} = \frac{600N}{\sin 35}$$

$$T_1 = 982N$$

$$\frac{T_2}{\sin 75^\circ} = \frac{600N}{\sin 35^\circ}$$

$$T_2 = 1010N$$

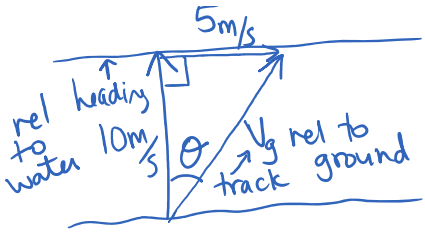
$$\frac{600(\sin 75^\circ)}{\sin 35^\circ}$$

Practice pg 16-17 #1-3

Boat and Airplane Problems

Example boat heads across river. Speedometer = 10m/s river flowing at 5.0m/s. How fast does the boat move relative to the bank? (inc. angle)

current



$$V_g^2 = 10^2 + 5^2$$
$$V_g = \sqrt{125}$$
$$= 11.1 \text{ m/s} \rightarrow 11 \text{ m/s}$$

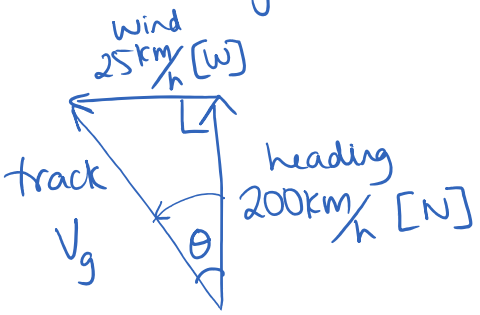
$$\tan\theta = \frac{5}{10}$$
$\theta = 27°$ to right of heading

3 vectors: heading, speedometer (relative to water or air)
river/wind
track - boat/plane relative to ground

Example (revisit warm up pg11)

airplane: N @ 200km/h wind: from E @ 25.0 km/h

find groundspeed and direction?



$$V_g = \sqrt{25^2 + 200^2}$$
$$= 202 \text{ km/h}$$ — groundspeed

$$\tan\theta = \frac{25}{200}$$ — track

$\theta = 7.13°$ W of N

3 vectors: airspeed, heading
groundspeed, track
windspeed, direction
↖ wind always given as where comes from.

Practice pg 20 # 1-2 (omit 3)

pg 21 # 1-9